IN THE U[illegible]TED STATES PATENT AND TRADE[illegible]ARK OFFICE

In re application of:

LOUIS B. ROSENBERG et al.

Serial No.: 08/461,170

Filed: June 5, 1995

For: THREE-DIMENSIONAL MECHANICAL MOUSE

Attorney Docket No.: IMM1P007A

Examiner: J. Brier

Group Art Unit: 2609

Date: February 20, 1996

CERTIFICATE OF MAILING

I hereby certify that this correspondence is being deposited with the United States Postal Service as First Class Mail to: Commissioner of Patents and Trademarks, Washington, DC 20231 on February 20, 1996.

Signed: Melissa Van Trease
Melissa Van Trease

Commissioner of Patents and Trademarks
Washington, DC 20231
Sir:

Transmitted herewith is an amendment in the above-identified application.

The fee has been calculated as shown below.

	Claims Remaining After Amendment		Highest Previously Paid For	Present Extra	SMALL ENTITY RATE FEE	OR	LARGE ENTITY RATE FEE
TOTAL CLAIMS	50	-	52	00	X11 = $00	OR	X22 = $
INDEP CLAIMS	07	-	06	01	X39 = $39	OR	X78 = $
[ ] Multiple Dependent Claim Present					IDS Fee $220 $125		$
and Fee Not Previously Paid					TOTAL $259		$

☒ Transmittal of Infomation Disclosure Statement Before Mailing Date of Either a Final Action or Notice of Allowance

☒ Information Disclosure Statement

☒ Forms 1449 with (29) Cited References

☒ Applicant(s) believe that no (additional) Extension of Time is required; however, if it is determined that such an extension is required, Applicant(s) hereby petition that such an extension be granted and authorize the Commissioner to charge the required fees for an Extension of Time under 37 CFR 1.136 to Deposit Account No. 08-2120.

☒ Enclosed is our Check No. 3672 in the amount of $259.00 to cover the additional claim and Information Disclosure Statement fee.

☒ If the required fees are missing or any additional fees are required to facilitate filing the enclosed response, please charge such fees or credit any overpayment to Deposit Account No. 08-2120 (Order No. IMM1P007A). A copy of this sheet is enclosed.

Respectfully submitted,
HICKMAN BEYER & WEAVER

James R. Riegel
Reg. No. 36,651

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Palo Alto, CA 94306
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HICKMAN BEYER & WEAVER, LLP

36

DT: 02/20/96

TO: PTO

FOR: Amendment Fee & IDS Fee

AMT: $259.00 (1) X-tra indep clm: $39.00
IDS Fee: $220.00 $259.00

FILE: IMM1P007A

HICKMAN BEYER & WEAVER

U.S.: ___ FOREIGN: ___
DOCKETED: 2/20/96 BY: VCM
ACTION: ___
DUE DATES: ___
ATTY: PCT/SRC DOCKET# IMM1P007A

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367

COMERICA BANK-CALIFORNIA
SAN JOSE, CALIFORNIA 95113
90-3752-1211

DATE 02/20/96

AMOUNT $259.00

Pay to the order of

COMMISSIONER OF PATENTS AND TRADEMARKS

Two-hundred fifty-nine and no/100**********

"003672" "121137522" 8501 03880 9"

Docket No.: IMM1P007A Serial No.: 08/461,170 Date: 02-20-96

By: JRR/jqn Filing Date: 06-05-95 Express Mail No.: ___

Inventor(s): Rosenberg et al.

For: THREE-DIMENSIONAL MECHANICAL MOUSE

The following has been received in the U.S. Patent Office on the date stamped hereon:

( ) ___ Patent Application Transmittal
( ) ___ Pages Specification & ___ Abstract
( ) ___ Sheets of Informal/Formal Drawings
( ) ___ Combined Declaration & Power Of Attorney
( ) ___ Assignment & Assignment Recordation Cover Sheet
(X) ___ Amendment C
(X) ___ Check No. 3672 in the amount of $ 259.00
( ) ___ Amendment After Final
( ) ___ Provisional
( ) ___ Cited References
( ) ___ Verified Statement Claiming Small Entity
( ) ___ Notice of Appeal
( ) ___ Restriction Response
( ) ___ Part B - Issue Fee Transmittal
( ) ___ Part C - Charge to Deposit Account
(X) ___ IDS/PTO Form 1449 w/29 Ref
( ) ___ Missing Parts Transmittal
( ) ___ Preliminary
(X) ___ Amendment Transmittal
(X) ___ Other Transm of IDS Stmt Bef Mail Date of Either a Final Action or NOA

HICKMAN BEYER & WEAVER, LLP

36

DT: 02/20/96

TO: PTO

FOR: Amendment Fee & IDS Fee

AMT: $259.00 (1) X-tra indep clm: $39.00
IDS Fee: $220.00 $259.00

FILE: IMM1P007A

HICKMAN BEYER & WEAVER

U.S.: X FOREIGN: ____
DOCKETED: 2/20/96 BY: VCM
ACTION: ____
DUE DATES: ____
ATTY: PCT DOCKET# IMM1P007A

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90-3752-1211

367

DATE	AMOUNT
02/20/96	$259.00

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COMMISSIONER OF PATENTS AND TRADEMARKS

Two-hundred fifty-nine and no/100**********

⑈003672⑈ ⑆121137522⑆ 8501⑈03880⑈9⑈

Docket No.: IMM1P007A Serial No.: 08/461,170 Date: 02-20-96
By: JRR/jqn Filing Date: 06-05-95 Express Mail No.: ____
Inventor(s): Rosenberg et al.
For: THREE-DIMENSIONAL MECHANICAL MOUSE

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(X) ___ Other Transm of IDS Stmt Bef Mail Date of Either a Final Action or NOA
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( ) ___ Verified Statement Claiming Small Entity
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( ) ___ Restriction Response
( ) ___ Part B - Issue Fee Transmittal
( ) ___ Part C - Charge to Deposit Account
(X) ___ IDS/PTO Form 1449 w/29 Ref
( ) ___ Missing Parts Transmittal

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FACSIMILE COVER SHEET
Date: February 23, 1996

CONFIDENTIALITY NOTE

Sender: Paul L. Hickman
Re: IMM1P007A (USSN 08/461,170)
Pages Including Cover Sheet(s): 33

Receiver: Jeffrey A. Brier (Art Unit 2609)
Company: USPTO
TEL # 703-305-4723
FAX # 1-703-308-5399

MESSAGE:

Enclosed is a copy of Amendment C that was filed with the USPTO on 2/20/96. I look forward to our meeting (along with the inventor) at your office on March 15, 1996 at 2 pm

OFFICIAL

Transmittal Letter

Patent
Docket No.: IMM1P007A

I hereby certify that this transmittal of the below described document is being deposited with the United States Postal Service in an envelope bearing First Class Postage and addressed to the Commissioner of Patents and Trademarks, Washington, D.C., 20231, on the below date of deposit.					
Date of Deposit:	02/20/96	Name of Person Making the Deposit:	Melissa Van Trease	Signature of the Person Making the Deposit:	

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Inventor(s): Louis B. Rosenberg et al.

Serial No.: 08/461,170 Group Art Unit: 2609

Filed: June 5, 1995 Examiner: J. Brier

Title: THREE-DIMENSIONAL MECHANICAL MOUSE

The Commissioner of Patents and Trademarks
Washington, D.C. 20231

Sir:

TRANSMITTAL OF INFORMATION DISCLOSURE STATEMENT BEFORE MAILING DATE OF EITHER A FINAL ACTION OR NOTICE OF ALLOWANCE (37 CFR 1.97(c))

Time of Transmittal of Accompanying Information Disclosure Statement

1. The information disclosure statement transmitted herewith is being filed after three months of the filing date of this national application or the date of entry of the national stage as set forth in §1.491 in an international application or after the mailing date of the first Office Action on the merits, whichever event occurred last but before the mailing date of either:

(1) a final action under §1.113 or

(2) a notice of allowance under §1.311, whichever occurs first

Certification or Fee

2. Accompanying this transmittal is:

(a) ___ a certification as specified in 37 CFR 1.97(e)

(b) X the fee set forth in 37 CFR 1.17(p) for submission of an information disclosure statement under §1.97(c). ($220.00).

James R. Riegel
Reg. No. 36,651

Date: February 20,1996
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[transl v.3.0 06/94]

PATENT

In the United States Patent and Trademark Office

Applicant: Rosenberg et al.
Applicant's Ref: IMM1P007A
Serial No: 08/461,170
(File Wrapper Continuation of
Serial No. 08/092,974)
Filed: 6/5/95
Title: Three-Dimensional Mechanical Mouse

Examiner: J. Brier
Group Art Unit: 2609

AMENDMENT C

Commissioner of Patents and Trademarks
Washington, D.C. 20231

Dear Sir:

In response to the Office Action mailed 12/12/95, please amend the above-identified patent application as follows:

In the Title:

Please delete the title and replace with the following: -- Electromechanical Human-Computer Interface with Force Feedback --.

In the Abstract:

Please delete the Abstract and replace with the following:

-- A method and apparatus for use with a computer for providing commands to a computer through tracked manual gestures and for providing feedback to the user through forces applied to the interface. A user manipulatable object is coupled to a mechanical linkage which is, in turn, supportable on a fixed surface. The mechanical linkage or the user manipulatable object is tracked by sensors for sensing the location and/or orientation of the object. A multi-processor system architecture is disclosed wherein a host computer system is interfaced with a dedicated microprocessor which is responsive to the output of the sensors and provides the host computer with information derived from the sensors. The host computer has an application program which responds to the information provided via the microprocessor and which can provide force-feedback commands back to the microprocessor. The force feedback is felt by a user via the user manipulatable object. --

In the Specification:

Page 1, line 6, after "providing" insert -- and receiving --.
Page 1, line 6, after "to" insert -- and from --.

Page 3, line 23, after "stylus", insert a new paragraph:

-- An embodiment of the present invention includes computer software and hardware which will provide force feedback information from the computer to the stylus. The computer sends feedback signals to the mechanical linkage which has force generators for generating force in response to images depicted on the computer screen. Incoming commands from the host computer are monitored by the microprocessor and instruct the microprocessor to report forces felt by a joint or set forces on a joint of the mechanical linkage. --

Page 4, line 8, change "loops" to -- loop --.

Page 5, line 18, after "apparatus", insert a new paragraph:

-- Also contemplated in the present invention is computer software and hardware which will provide feedback information from the computer to the stylus and cause forces on the stylus. This implementation is described in greater detail subsequently. --

Page 7, line 29, change "11" to -- 11' --.
Page 10, line 19, change "3A" to -- 3 --.

Page 11, line 10, change "computer" to -- compute --.

Page 11, line 11, change "once" to -- once, --.

Page 11, line 16, after "cease, " insert -- and --.

Page 12, line 3, change "commend" to -- command --.

Page 13, line 3, after "Forces felt by a joint", add -- are reported, and --.

Page 13, line 4, delete the comma after "resistance" and change "reported" to -- accomplished --.

Page 13, line 6, change "forced-reflecting" to -- force-reflecting --.

Page 13, line 9, change "locking or unlocking a joint" to -- lock or unlock a joint, --.

Page 13, line 10, change "control signals reading from a force sensor to force-reflection hardware but do not" to -- control signals are used to command force-reflection hardware, and do not --

Page 13, line 12, change "of" to -- from -- and, after "device", insert -- to the host computer --.

Page 14, line 28, change "counter-wight" to -- counter-weight --.

In the Claims:

Claims that have been changed by this amendment are presented below and marked as "amended."

1. (amended) An interactive device for use in conjunction with a host computer, images displayed on a computer display screen, [apparatus] and a fixed surface, comprising:

a stylus [including a longitudinal axis, a lateral axis, and a vertical axis] having a pencil-like configuration to allow writing-like manipulations between fingers of a user;

a mechanical linkage coupled to a fixed surface and coupled to said stylus for supporting said stylus while allowing at least five degrees of freedom in the motion of said stylus, said mechanical linkage providing a user the ability to manipulate both the orientation and location of said stylus in three-dimensional space [, said five degrees of freedom including rotation about said longitudinal axis, revolution about its lateral axis, turning about its vertical axis, and spatial movement along at least two other axes relative to said fixed surface, said rotation, revolution and turning degrees of freedom providing said orientation of said stylus, and said spatial movment degrees of freedom providing said location of said stylus]; and

[means] a sensor for producing an interactive stylus locative signal which [on command by a user] is responsive to and corresponding with the position and movement of the stylus at any point in time during its normal operation, said stylus locative signal providing information about

the orientation, location, and movement of said stylus for use by said host computer and said [a] computer display [apparatus] screen to manipulate images displayed by said computer display [apparatus] screen in accordance with said orientation, location, [and] or movement of said stylus, said images including a cursor whose position on said computer display screen is controlled by said stylus locative signal; and

a force generator for generating a force on said stylus in at least one of said five degrees of freedom in response to force signals provided to said interactive device, said force signals correlated to information displayed on said computer display screen.

Please cancel claims 3-4 without prejudice.

5. (amended) A device as recited in Claim 1 further comprising:

a remote unit having a switch capable of being in an on state and an off state; and

command means triggered by said switch when said switch is in its on state for generating a command signal for receipt by [a] said host computer, wherein an action taken by said computer upon receipt of said command is dependent on said state of said switch.

6. A device as recited in Claim 5 wherein said remote unit is a foot pedal unit.

7. (amended) A device as recited in Claim 1 wherein said mechanical linkage includes at least [three] five joints, wherein a configuration of said joints allows said stylus to spin freely about an axis extending through the length of said stylus while all of said other joints remain fixed in position, and a sensor for sensing said spin and providing a signal describing said spin to said host computer.

8. (amended) A device as recited in Claim [1] 7 wherein three joints of said mechanical linkage closest to said stylus [includes three individual components] control said orientation of said stylus, said orientation being variable by a user while a position of a point on said stylus remains fixed.

Please cancel claims 9-11 without prejudice.

12. (amended) A method for interactively interfacing a user and a computer display apparatus, comprising the steps of:

providing a stylus [including a longitudinal axis, a lateral axis and a vertical axis] having a pencil-like configuration that allows writing-like manipulations between fingers of said user;

coupling to said stylus a mechanical linkage coupled to a fixed surface for supporting said stylus while allowing at least five degrees of freedom in the motion of said stylus, said mechanical linkage for providing a user the ability to manipulate the orientation and location of said stylus in three-dimensional space, [said at least five degrees of freedom including rotation of said stylus

about its longitudinal axis, revolution of said stylus about its lateral axis, turning of said stylus about its vertical axis, and spatial movement of said stylus along at least two other axes relative to said fixed surface, said rotation, revolution and turning degrees of freedom providing said orientation of said stylus, and said translation degrees of freedom providing said location of said stylus]; [and]

[providing means for] producing an interactive stylus locative signal which [on command by a user] is responsive to and corresponding with the position and movement of the stylus at any point in time during its normal operation, said stylus locative signal providing information about the orientation and location of said stylus;

displaying a cursor on said computer display apparatus, said [for use by a] computer display apparatus using said stylus locative signal to position and move [an object displayed by said computer display apparatus] said cursor in accordance with the location, orientation, [and] or movement of said stylus;

providing feedback means for generating force on said stylus in at least one of said degrees of freedom in response to force signals provided by said host computer to said mechanical linkage, said force signals correlated to information displayed on said computer display apparatus; and

providing a remote unit switch capable of being in at least two states and a command device for generating a command signal representing said state of said switch and for receipt by said host computer, wherein an action taken by said computer when receiving said command signal depends on said state of said switch.

Please cancel claims 14-16 without prejudice.

17. (amended) A method as recited in Claim [16] 12 wherein said remote unit switch is a foot pedal unit.

Please cancel claims 18 and 19 without prejudice.

20. (amended) A method as recited in Claim [13] 12 wherein said mechanical linkage includes counterweights for reducing an adverse influence of gravity on said motion of said stylus when said user moves said stylus [further comprising means for providing resistance to the motion of the stylus].

Please cancel claims 21 and 22 without prejudice.

29. A device as recited in Claim 1 wherein said mechanical linkage provides said stylus with six degrees of freedom.

30. (amended) A method as recited in Claim [13] 12 wherein said mechanical linkage provides said stylus with six degrees of freedom.

Please cancel claim 31 without prejudice.

32. (amended) A method as recited in Claim [28] 12 wherein said [means supportable on a fixed surface and coupled to said stylus provides the ability to track said motion capabilities of said stylus] said stylus locative signal is produced by appropriately placed sensors.

Please cancel claim 33 without prejudice.

34. (amended) A device as recited in claim [11] 1 wherein said feedback means generates a force on said stylus by generating a force on a joint included in said mechanical linkage in response to said force signals.

35. (amended) An interactive device for use in conjunction with a host computer, a computer display apparatus and a fixed surface, comprising:

a stylus that can be grasped and manipulated by a user;

a mechanical [arm] linkage coupled to a fixed surface and coupled to said stylus for supporting said stylus while allowing a plurality of degrees of freedom in the motion of said stylus [, said mechanical arm linkage providing a user the ability to manipulate the orientation and location of said stylus in three-dimensional space];

a sensor coupled to said mechanical [arm] linkage for sensing [said orientation and said] a location of said stylus and providing a stylus locative signal to a computer display apparatus, said stylus locative signal providing information about said orientation and location of said stylus for use by said computer display apparatus to manipulate an image displayed by said computer display apparatus in accordance with said [orientation and] location of said stylus, said image including a computer cursor having a position controlled by said location of said stylus;

a feedback device for [providing] generating a force [along] in at least one of said plurality of degrees of freedom of said stylus in response to a stylus force signal [generated] provided by said host computer [display apparatus] to said interactive device, said force signal being output to said feedback device when said computer cursor interacts with other images displayed on said computer display apparatus; and

a user actuated switch capable of being in a least two states and a command device for generating a command signal for receipt by said host computer, said command signal representing

a state of said switch and being received by said host computer, wherein an action taken by said computer when receiving said command signal depends on said state of said switch.

Please cancel claim 36 without prejudice.

37. (amended) An interactive device as recited in claim 35 wherein when said [transducer provides said force in conjunction with movment of said object] cursor displayed on said computer display apparatus moves into a different image displayed on said computer display apparatus, a force signal is output and a force is generated in at least one of said plurality of degrees of freedom.

38. An interactive device as recited in claim 35 wherein said mechanical arm linkage allows six degrees of freedom in the motion of said stylus.

39. (amended) A system for controlling an electromechanical interface apparatus manipulated by a user, the system comprising:

a host computer system for receiving [an] a microprocessor input control signal and for providing [a] high-level host [output control signal] commands, wherein said host computer system [updates] modifies a displayed process in response to said microprocessor input control signal and in proportion to a position or orientation of a physical object manipulated by a user;

a [processor] microprocessor separate from said host computer system for receiving said high-level host [output control signal] commands from said host computer system and providing a [processor] microprocessor output control signal;

an actuator coupled to said physical object and controlled by [for receiving] said [processor] microprocessor output control signal and providing a force along a degree of freedom to [a] said user manipulable physical object [coupled to said actuator in accordance with] in response to said processor output control signal; [and]

a sensor for [detecting] tracking motion of said manipulable physical object along said degree of freedom and [outputting] for outputting [said input control] a locative signal which is responsive to and represents [including information representative of] the position or orientation of said physical object, wherein said microprocessor is responsive to said locative signal, derives said microprocessor input control signal at least in part from said locative signal, and sends said microprocessor input control signal to said host computer system;

local memory separate from memory of said host computer system, said local memory comprising non-volatile memory;

program instructions stored in said non-volatile memory for enabling communication between said microprocessor and said host computer system and for decoding at least one of said high level host commands; and

a plurality of command routines stored in said local memory, at least one of said command routines allowing said microprocessor to control said actuator in accordance with at least one of said decoded high-level commands, and at least one of said command routines reporting said input control signal to said host computer in accordance with at least one of said decoded high-level commands.

Please cancel claim 40 without prejudice.

41. (amended) A system as recited in claim [40] 39 wherein said [processor] microprocessor [is operative to provide said processor output control signal to said actuator] selects one of said command subroutines [in accordance with a processor subroutine selected in accordance with] as instructed by said host [output control signal] commands and controls said actuator by following instructions of said selected command subroutine.

Please cancel claim 42 without prejudice.

43. (amended) A system as recited in claim [42] 39 wherein said [stylus] physical object can be moved by said user in a plurality of degrees of freedom, and wherein said system further comprises, for each of said plurality of degrees of freedom, an actuator for providing a force along a degree of freedom of said object, and a sensor for detecting motion of said object in said degree of freedom.

44. (amended) A system as recited in claim [40] 39 wherein said force provided by said actuator is a resistive force to motion of said physical object in said degree of freedom.

45. (amended) A system as recited in claim [40] 39 further comprising a serial interface coupled between said host computer and said [processor] microprocessor for outputting said host [output control signal] command from said host computer system to said [processor] microprocessor and for receiving said microprocessor input control signal at said host computer system from said [processor] microprocessor.

46. (amended) A system as recited in claim [40] 39 wherein said host computer system displays images on a visual output device and manipulates said images in accordance with said position of said physical object.

47. (amended) A system as recited in claim [40] 39 further comprising a peripheral [input device] switch coupled to said [processor] microprocessor for providing input signals to said [processor] microprocessor [to be sent to said host computer] when a user manipulates said peripheral [input device] switch, wherein said microprocessor reports a state of said switch to said

host computer system, said state causing said host computer system to modify said displayed process.

48. (amended) A method for interfacing motion of an object with a host computer system, the method comprising the steps of:

providing [an] a physical object having a degree of freedom;

sensing positions of said physical object along said degree of freedom with a sensor and producing electrical sensor signals therefrom;

utilizing a microprocessor separate from said host computer system to receive said electrical sensor signals, provide said electrical sensor signals to said host computer system, and to receive host commands from said host computer system; [and]

creating a force on said object along said degree of freedom by using said microprocessor and said host commands to control an actuator coupled to said physical object;

providing a non-volatile memory device coupled to and provided local to said microprocessor and being accessible by said microprocessor; and

providing program instructions stored in said non-volatile memory for enabling communication between said microprocessor and said host computer system and for allowing said microprocessor to control said actuators in accordance with force commands provided by said host computer system.

49. A method as recited in claim 48 wherein said microprocessor and said host computer system are coupled together by a serial communication interface.

50. (amended) A method as recited in claim 48 wherein said microprocessor provides processor commands to said actuator in accordance with a processor subroutine selected in accordance with said host commands and stored on a memory device coupled to said [processor] microprocessor.

51. (amended) A method as recited in claim 48 wherein said host computer system controls and displays visual images on a visual output apparatus in accordance with said positions of said physical object.

52. (amended) A method as recited in claim 51 wherein said physical object includes a stylus that can be moved by said user in at least five degrees of freedom.

53. A method as recited in claim 48 further comprising sending a peripheral command to said microprocessor from a peripheral input device, wherein said microprocessor sends said peripheral command to said host computer system.

54. (amended) An interface device manipulated by a user and communicating with a host computer system displaying visual images on a screen, said host computer system updating said visual images in response to input signals, said interface device comprising:

a [processor] microprocessor, separate from said host computer system, for communicating with said host computer system via a communication interface by receiving a host command from said host computer system, said [processor] microprocessor being controlled by software instructions stored on a memory device coupled to said [processor] microprocessor, said software instructions enabling said communication between said host computer system and said microprocessor;

a user object movable in a degree of freedom by a user and being physically contacted by said user;

an actuator electrically coupled to said [processor] microprocessor for applying a force along a degree of freedom to said user object in accordance with a processor command from said [processor] microprocessor, said processor command being derived from said host command, wherein said software instructions on said memory device includes a routine that allows said microprocessor to control said actuator in accordance with said host command; and

a sensor for detecting a position of said user object along said degree of freedom and outputting sensor information that is included in said input signals [to] received by said host computer system, said [input signals] sensor information including information representative of said position of said user object.

55. (amended) An interface device as recited in claim 54 wherein said sensor is electrically coupled to said [processor] microprocessor, wherein said sensor outputs said [input signals] sensor information to said [processor] microprocessor, and wherein said [processor] microprocessor sends said input signals that include said sensor information to said host computer system.

56. (amended) An interface device as recited in claim 55 wherein said [processor] microprocessor is operative to [provide said processor command to said actuator] receive said sensor information from said sensor in accordance with a processor [subroutine] routine selected in accordance with said host command and stored in said memory device.

57. An interface device as recited in claim 55 wherein said user object is movable in at least two degrees of freedom.

58. An interface device as recited in claim 55 wherein said communication interface includes a serial interface.

59. An interface device as recited in claim 55 wherein said actuator applies a resistive force along said degree of freedom to said user object.

Please cancel claim 60 without prejudice.

Please add the following claims:

61. (new) A device as recited in Claim 1 further comprising a button provided on said stylus, said button generating a command signal for receipt by said host computer when said button is pressed by said user.

62. (new) A system as recited in claim 39 wherein said command routines are stored in said non-volatile memory.

63. (new) A system as recited in claim 47 wherein said reporting of said state of said switch to said host computer system is controlled by at least one of said command subroutines.

64. (new) A system as recited in claim 63 wherein a peripheral switch coupled to said microprocessor for providing input signals to said microprocessor when a user manipulates said peripheral switch, wherein said microprocessor reports a state of said switch to said host computer system, said state causing said host computer system to modify said computer-implemented process, and wherein said reporting of said state by said microprocessor is controlled by one or more of said command routines.

65. (new) An interface device as recited in claim 50 wherein said microprocessor is provided on board an interface device coupled to said physical object, said interface device being physically separate from said host computer system and coupled to said host computer system by a bus.

66. (new) An interface device as recited in claim 48 wherein said program instructions include a processor routine to instruct said microprocessor to monitor and decode said host commands from said host computer system and wherein said subroutine is one of a plurality of available routines which said microprocessor calls and executes in accordance with said host command.

67. (new) An interface device as recited in claim 54 wherein said microprocessor is provided on board said interface device.

68. (new) An interface device as recited in claim 67 wherein said microprocessor monitors and decodes said host commands from said host computer system and wherein said routine in

said memory device is one of a plurality of available routines which said microprocessor calls and executes in accordance with said host command.

69. (new) An interface device as recited in claim 68 further comprising a peripheral switch electrically coupled to said microprocessor and capable of being in one of two states, and wherein said host command to said microprocessor causes said microprocessor to execute code in said memory that allows said microprocessor to report said state of said peripheral switch to said host computer system.

70. (new) An interface device as recited in claim 68 wherein said host command causes said microprocessor to call and execute a routine to set communication parameters for communication between said microprocessor and said host computer.

71. (new) An interface device as recited in claim 68 wherein said host command causes said microprocessor to call and execute a routine to read said sensor information and provide said input signals to said host computer.

72. (new) An interface device as recited in claim 68 wherein said user object is coupled to a mechanical linkage having a plurality of joints, and wherein said host command causes said microprocessor to call and execute a routine to set a force on a joint of said mechanical linkage.

73. (new) An electromechanical interface apparatus manipulated by a user for interfacing with a host computer system, said host computer system receiving a microprocessor input control signal and providing high-level host commands, wherein said host computer system modifies a displayed process in response to said microprocessor input control signal and based on a position or orientation of a physical object manipulated by said user, the interface apparatus comprising:

a microprocessor separate from said host computer system for receiving said high-level host commands from said host computer system and providing a microprocessor output control signal;

an actuator coupled to said physical object and controlled by said microprocessor output control signal and providing a force along a degree of freedom to said user manipulable physical object in response to said processor output control signal;

a sensor for tracking motion of said manipulable physical object along said degree of freedom and for outputting a locative signal which is responsive to and represents the position or orientation of said physical object, wherein said microprocessor is responsive to said locative signal, derives said microprocessor input control signal at least in part from said locative signal, and sends said microprocessor input control signal to said host computer system;

local memory separate from memory of said host computer system, said memory comprising non-volatile memory;

program instructions stored in said non-volatile memory for enabling communication between said microprocessor and said host computer system and for decoding said high level host commands; and

a plurality of command routines stored in said local memory, at least one of said command routines allowing said microprocessor to control said actuator in accordance with at least one of said decoded host commands, and at least one of said command routines reporting said input control signal to said host computer in accordance with at least one of said decoded host commands.

74. (new) An electromechanical interface apparatus as recited in claim 73 wherein said microprocessor input control signal received by said host computer system includes information indicative of which host command said microprocessor is responding to.

75. (new) An electromechanical interface apparatus as recited in claim 73 wherein said host command causes said microprocessor to repeatedly send said microprocessor input control signal to said host computer system until a different host command is received by said microprocessor to cease sending said microprocessor input control signal.

76. (new) An electromechanical interface apparatus as recited in claim 73 wherein said microprocessor can compute a position and orientation of said physical object using kinematic equations and said locative signal.

REMARKS

Claims 1, 5-8, 12, 17, 20, 29, 30, 32, 34, 35, 37-39, 41, 43-59 and 61-76 are pending in this application. Claims 1, 5, 7, 8, 12, 17, 20, 30, 32, 34, 35, 37, 39, 41, 43-48, 50-52, and 54-56 have been amended to expedite prosecution. Claims 3-4, 9-11, 14-16, 18, 19, 21, 22, 31, 33, 36, 40, 42, and 60 have been cancelled by this Amendment C, and claims 61-76 have been added. Applicant reserves the right to reintroduce claims of comparable scope to the original claims in a continuation or other related application.

The Examiner objected to the Abstract of the Disclosure. Since, after amendments, all of the independent claims of the present application are now directed to a force feedback embodiment, Applicant has deleted the previous abstract and has added a new abstract as provided above. Applicant respectfully requests that the objection to the Abstract be withdrawn.

Applicant has made minor grammatical corrections to the specification. In addition, Applicant has amended the title and specification to emphasize the force feedback feature of the present invention that is present in the claims. The previous title has been deleted and a new title has been provided to more appropriately describe the invention recited in the claims. Applicant has simlarly amended the specification to emphasize the force feedback element of the claims. More specifically, Applicant has added a paragraph to the summary on page 3 which includes the language of the detailed description on page 11, lines 17-20, and on page 13, lines 13-25. Applicant has also added a paragraph to the beginning of the detailed description at page 5. This new paragraph includes the language from lines 13-22 on page 13 and refers to this page 13 description. The new paragraphs therefore include description that was present in the original filing of the application and are not new matter.

The Examiner objected to claims 15-22 and 30-32 as being dependent directly or indirectly upon cancelled claims. Applicant has amended the claims accordingly, and respectfully requests that this objection be withdrawn.

The Examiner rejected claims 1, 3-10, 12, 14-21, and 29-33 under 35 U.S.C. §112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which Applicant regards as the invention. Applicant has amended independent claims 1 and 12 to remove the language defining the axes, and respectfully requests that the rejection under §112, second paragraph, be withdrawn.

§103 Rejections

The Examiner rejected claims 1, 3-10, 12, 14-21, and 29-34 under 35 U.S.C. §103 as being unpatentable over Hara (U.S. Patent 5,379,663) and Davies (U.S. Patent No. 4,593,470). Applicant respectfully traverses. Hara discloses a joystick device that can be moved in up to six degrees of freedom and is used for controlling a device or object such as a manipulator (col. 1, lines 12-14). Davies discloses a graphics tablet having an articulated arm and a tip element for providing three-dimensional, spatial (x, y, z) coordinates of the location of the tip element in a defined volume to a computer.

In contrast, claim 1 recites a stylus coupled to a mechanical linkage and a sensor for producing a stylus locative signal indicating the orientation, location or movement of the stylus and which is used by the host computer to manipulate images on a display screen using the stylus locative signal. The images include a cursor having a position on the screen that is controlled by the stylus locative signal, as disclosed on page 13, lines 13-25 of Applicant's specification. Applicant's invention thus provides a versatile interface between a user handling a stylus and images displayed by the controlling computer apparatus. These features are neither disclosed nor reasonably suggested by Hara and Davies. Hara discloses a joystick handle device which is grasped by a user and is oriented to be used while the user is sitting in a chair. The user is intended to control a device such as a robotic manipulator (col. 1, lines 12-14), not images displayed on a computer apparatus. Likewise, Davies discloses a stylus element for tracing 3-D objects and inputting the object's coordinates into a computer. Only x, y and z coordinates are input to the host computer in Davies to represent a model that has been traced by the stylus. Davies does not use a stylus as an interface to manipulate images, such as a cursor, displayed by a computer. Thus, there is no suggestion in either Hara or Davies for producing a locative signal that provides the orientation, location, or movement of the stylus to a computer, which displays images such as a cursor whose position is controlled by the stylus locative signal.

In addition, claim 1 has been amended to incorporate subject matter of dependent claim 11 and recites a force generator for generating a force on the stylus in at least one of the five of degrees of freedom. The force is generated in response to force signals provided to the interactive device which are correlated to information displayed on the computer display screen. As stated by the Examiner in the second §103 rejection (point 7) of the Office Action, the combination of Hara and Davies fails to teach the concept of integrating force feedback in the stylus position detection system. In that rejection, the Examiner stated that it would have been obvious to one of ordinary skill in the art to include a means for providing feedback to the user, and cites the Fischer article as an example. However, Applicant believes that it would not be obvious to add a such a force feedback system to the interactive device recited in claim 1. The prior art discloses force feedback gloves for interacting with virtual environments, which are "floating" devices that are freely moved when worn by a user. None of the prior art references discloses using a stylus and a

mechanical linkage attached to a fixed support in which force feedback is applied. There is no teaching or suggestion of utilizing force feedback with the stylus of Davies, since the Davies stylus is only used to input coordinates; force feedback is useless and would be a detriment to the desired free movement of the stylus in the Davies embodiment. Hara also does not disclose or suggest including force feedback in his manipulator device. Applicant therefore believes that claim 1 is patentable over Hara in combination with Davies and the Fischer article.

Claims 5-8 are dependent from claim 1 and are patentable over the cited references for at least the same reasons as recited with respect to claim 1. Claim 7 additionally recites that the configuration of joints on the mechanical linkage allows the stylus to spin freely about an axis extending through the length of the stylus while the other joints remain fixed in position. This spin motion, for example, is disclosed as degree of freedom 6 in Figure 8 of Applicant's specification. Motion in this degree of freedom is not used, and is not useful, to the embodiment disclosed by Davies. In Davies, the x, y, and z coordinates of a model are input to a computer, and the spin of the stylus does not provide any additional information when sensing these spatial coordinates. Applicant's claim 1, however, includes this motion to change the orientation of the stylus and includes a sensor to provide a stylus locative signal that describes the spin movement to the host computer. This spin movement can be useful when controlling the position of images, such as a cursor, displayed on a display screen. None of the references cited by the Examiner disclose or suggest a stylus with a spin type of motion.

Claim 8 additionally recites that the three joints closest to the stylus control the orientation of the stylus, where the orientation is variable by a user while a position of a point on the stylus remains fixed. For example, a point on the tip of the stylus can remained fixed at a single x, y, and z spatial point while the length of the stylus behind the tip is rotated or moved to change its orientation; this is possible due to the configuration of joints disclosed by Applicant. Such orientation movement is not disclosed or suggested by Davies, since moving the orientation of the stylus is useless to Davies' spatial coordinate input method. Hara also does not disclose such movement.

Claim 12 recites a method similar to the device of claim 1, including a cursor displayed by a computer display apparatus and a feedback means for generating force on the stylus. Claim 12 is therefore patentable over the cited art for similar reasons explained with reference to claim 1. Claims 17, 20, 30, and 32 are dependent from claim 12 and are patentable over the cited references for at least the same reasons as claim 12.

Applicant therefore believes that claims 1, 5-8, 12, 17, 20, 29, 30, 32, and 34 are patentable over the cited art, and respectfully requests that the rejection under § 103 be withdrawn.

The Examiner rejected claims 11, 22, and 35-60 under 35 U.S.C. §103 as being unpatentable over Hara in view of Davies and Fischer et al. Claims 11 and 22 have been cancelled. Claim 35 recites an interactive device similar to that of claims 1 and 5. The force signal in claim 35 is output to the feedback device when the computer cursor interacts with other images displayed on the computer display apparatus. For example, a cursor moving into a surface generated on a computer screen can be sensed and forces provided on the stylus accordingly, as disclosed in Applicant's specification on page 13, lines 13-25 and recited in dependent claim 37. The features of a stylus controlling a cursor on a screen and providing force feedback in accordance with interaction of displayed images are not disclosed or suggested in any of the references of Hara, Davies, or Fischer et al. Claims 37 and 38 are dependent on claim 35 and are thus patentable over the cited references for at least the same reasons as claim 35.

Claim 39 recites a system for controlling an interface apparatus that includes a host computer system, a microprocessor separate from the host computer system, an actuator for providing a force along a degree of freedom of a physical object, a sensor for detecting motion of the physical object, a memory, program instructions stored in the memory, and command routines stored in the memory. Applicant's claim recites a microprocessor, separate from the host computer system that receives commands from the host and controls an actuator to provide forces on the physical object. The microprocessor also receives a locative signal from the sensor and sends a microprocessor input control signal, derived from the locative signal at least in part, to the host computer. None of the cited references disclose a separate microprocessor that acts as an intermediary between a host computer system and an actuator or sensor. The Davies patent discloses providing coordinate data directly from potentiometers (sensors) to a host computer (col. 3, lines 47-50) or to an analog to digital converter between the potentiometer and host computer, but does not disclose providing a microprocessor to interface the potentiometers and host computer. The Hara patent discloses outputting signals to a controlled device such as a manipulator, not to a separate microprocessor. The Fischer reference does not disclose any circuitry at all, let alone a separate microprocessor as in Applicant's claim 39.

In addition, claim 39 recites that local memory is provided separate from memory of the host computer and comprises non-volatile memory. An example of such memory is disclosed on page 8, lines 24-26 of Applicant's specification as a ROM memory device. Program instructions stored in the memory enables communication and allows the microprocessor to decode commands. Command routines in the memory control the actuator in accordance with host commands. Neither Hara nor Davies disclose force feedback, and thus do not disclose such program instructions nor routines used with host commands. Fischer also does not disclose or suggest providing commands to exert forces nor controlling forces and input using such program instructions and routines. Applicant therefore believes that claim 39 is patentable over the Hara, Davies, and Fischer references.

Claims 41 and 43-47 are dependent from claim 39 and are patentable over the cited references for at least the same reasons as claim 39. In addition, claim 45 recites that a serial

interface is provided between the microprocessor and host computer system, as disclosed in Figure 2A of Applicant's specification. None of the cited references disclose or suggest providing a serial interface to a separate microprocessor used for force feedback operation. Applicant's separate microprocessor, in fact, allows a relatively slow serial interface to be feasible for force feedback applications, since, for example, the microprocessor can directly control the actuator at the necessary high speeds while the commands from the host computer can be provided serially to the microprocessor at a slower rate. Applicant therefore believes claims 39, 41 and 43-47 are patentable over Hara in view of Davies and Fischer et al.

Claim 48 recites a method for interfacing motion of an object with a host computer system which includes steps similar to elements of the system of Figure 39. A separate microprocessor is used to receive signals from a sensor and send the sensor signals to the host computer, as well as receive host commands used to control an actuator. A memory device stores program instructions to enable communication and actuator control. As explained with reference to claim 39, these features are patentable over the cited art. Claims 49-53 are dependent from claim 48 and are patentable over the cited art for at least the same reasons as claim 48. Claim 49 recites a serial interface similar to claim 45 and is similarly patentable.

Claim 54 recites an interface device communicating with a host computer system displaying visual images on a screen. The recited elements in claim 54 are similar to elements of claim 39, described above, in which a microprocessor provides commands to an actuator based on host commands. None of the cited references disclose using host commands or force commands with a microprocessor, and claim 54 is thus believed patentable over Hara, Davies, and Fischer et al. Claims 55-59 are dependent on claim 54 and are patentable over the cited references for at least the same reasons as claim 54. Claim 56 additionally recites that the microprocessor receives sensor information in accordance with a processor routine selected by the host command. This is disclosed in Applicant's specification on page 10, lines 19-26 and is not disclosed or suggested by the art cited by the Examiner.

Claims 61-76 have been added by this amendment. Claim 61 is dependent from claim 1 and recites that a button on the stylus is used to send a command signal to the host computer, as disclosed on page 7, lines 30-32. Claims 62-64 depend from claim 39. Claim 63 recites that the program instructions include command routines that are executed when instructed by the host commands, an example of which is disclosed on page 10, lines 19-32 and page 11 lines 1-20. Claim 64 recites that the state of the peripheral switch is reported and controlled by one or more command routines. Claims 65 and 66 depend from claim 48 and recite similar subject matter. Claims 67-72 depend from claim 54. Claim 67 recites that the microprocessor is provided on board the interface device, as disclosed on page 9, lines 25-29. Claim 68 recites that the microprocessor monitors and decodes the host commands, and that multiple available routines can be called by the microprocessor in accordance with the host command, as disclosed on page 10, lines 19-32 and page 11 lines 1-20. Claim 69 recites executing code to report the state of a peripheral switch, claim 70 recites setting communication parameters using a routine, claim 71

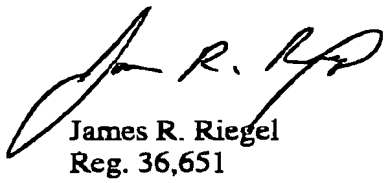
recites reporting sensor readings using a routine, and claim 72 recites setting a force on a joint using a routine; these features are disclosed on pages 10 and 11. None of these features are disclosed or suggested by the cited references, which do not make mention of a separate microprocessor, routines used by such a microprocessor, or the actions controlled by the routines.

New claim 73 recites an interface apparatus having substantially similar elements as claim 39, and is patentable over the cited references for reasons similar to those described for claim 39. Claims 74-76 are dependent from claim 73 and recite additionally-patentable subject matter disclosed in Applicant's specification on page 12, lines 10-12 (claim 74), page 10, lines 27-32 (claim 75) and page 12, lines 26-32 (claim 76).

Applicant believes that claims 35, 37-39, 41, 43-59, and 61-76 are patentable over Hara in view of Davies and Fischer et al., and respectfully requests that the rejection under § 103 be withdrawn.

In view of the foregoing, Applicant believes that all pending claims are allowable and respectfully requests a Notice of Allowance from the Examiner. Should the Examiner believe that a telephone conference would expedite the prosecution of this application, the undersigned can be reached at the telephone number set out below.

Respectfully submitted,



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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re the application of

LOUIS B. ROSENBERG et al.

Serial No.: 08/461,170

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Art Unit: 2609

Examiner: J. Brier

February 20, 1996

CERTIFICATE OF MAILING

I hereby certify that this correspondence is being deposited with the United States Postal Service as First Class Mail in an envelope addressed to: Commissioner of Patents and Trademarks, Washington, DC 20231 on February 20, 1996.

Signed: Melissa Van Trease

Melissa Van Trease

INFORMATION DISCLOSURE STATEMENT
UNDER 37 CFR §§1.56 AND 1.97

Commissioner of Patents and Trademarks
Washington, DC 20231

Dear Sir:

The references listed in the attached PTO Form 1449, copies of which are attached, may be material to examination of the above-identified patent application. Applicants submit these references in compliance with their duty of disclosure pursuant to 37 CFR §§1.56 and 1.97. The Examiner is requested to make these citations of official record in this application.

This Information Disclosure Statement is not to be construed as a representation that a search has been made, that additional information material to the examination of this application does not exist, or that these references indeed constitute prior art.

Respectfully submitted,

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